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ENERGY SUSTAINABILITY AND THE ARMY: THE CURRENT TRANSFORMATION

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The purpose of this paper is to examine the utilization of conservation, and renewable energy systems, (RES), for the purposes of sustainability and national security. This will allow the United States Army to transform itself on more secure business footing. It will also encourage both CONUS Army Installations and OCONUS Forward Operating Bases to reduce dependency on foreign oil. The Army is currently in the process of transforming itself to run more like a business in order to better develop, operate, and maintain forces for a period of time in extended conflict. This creates many challenges regarding the sustainability of resources. One of these challenges particularly identified with the military, is that we have too great a dependence on foreign oil in order to operate and meet mission. Due to anticipated fiscal constraints, it is imperative the Army not only operate and meet mission, but also learn to do so in a more sustainable fashion. By utilizing a business approach, the goals and objectives would be to implement conservation measures, as well as utilize RES. This would in turn make CONUS Army Installations and OCONUS Forward Operating Bases more energy sustainable and even net energy producers. If the Army does not avail itself to other forms of alternative energy, the end result may pressure a pull back of overseas military operations, due to national economic constraints. Lastly, it will also have strategic implications of America's dependence on foreign oil in a time of geopolitical instability.

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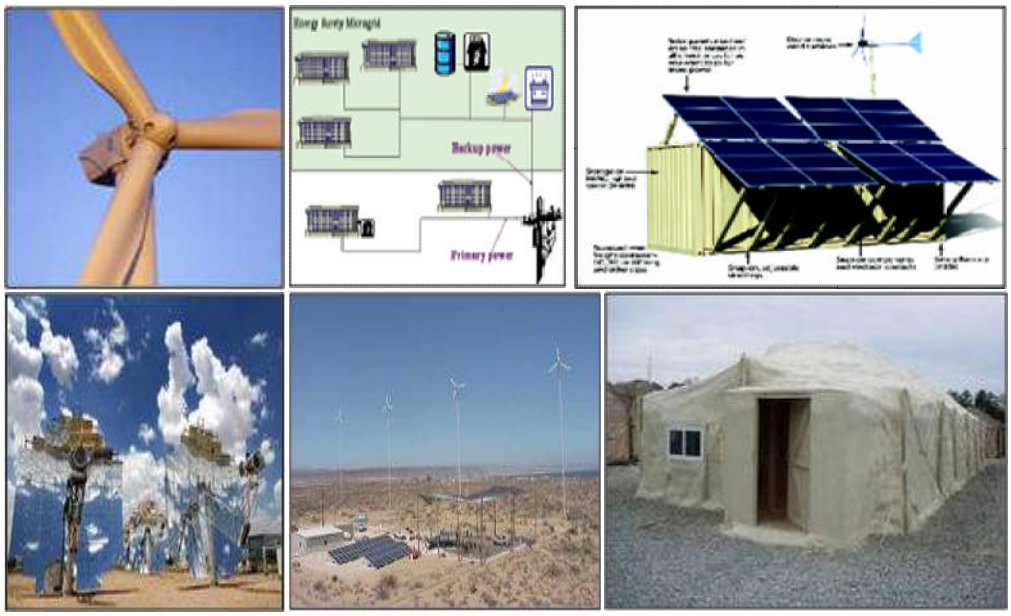

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USAWC CIVILIAN RESEARCH PROJECT

ENERGY SUSTAINABLITY AND THE ARMY: THE CURRENT TRANSFORMATION

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ACRONYMS

AESIS	Army Energy Security Implementation Strategy
AESTF	Army Energy Security Task Force
CAFÉ	Corporate Average Fuel Economy
CONUS	Continental United States
CRP	Civilian Research Project
DSB	Defense Science Board
DOD	Department of Defense
DOE	Department of Energy
ESG	Energy Security Goals
FOB	Forward Operating Base
FT SPR	Fischer-Tropsch Strategic Petroleum Reserve
KW	Kilowatt
LED	Light Emitting Diode
MW	Megawatt
NATO	National Alliance Treaty Organization
NEV	Neighborhood Electric Vehicle
NTV	Non Tactical Vehicle
OACSIM	Office of Assistant Chief Of Staff for Installation Management
OCONUS	Outside the Continental United States
OPEC	Organization of Petroleum Exporting Countries
RDF	Refuse Derived Fuel
RES	Renewable Energy Systems

SEO	Strategic Energy Objectives
U.S.	United States

DEFINITION OF TERMS

Affordability	Provide advice and guidance to the Command leadership developing resource requirements, sources of funding, determining cost, acquiring funds, distributing and controlling funds, tracking cost, and reimbursement procedures providing accounting support and establishing a management internal control process.
Maintainability	Retain material or equipment into a serviceable condition in order to accomplish the mission, and to also keep a facility or utility System in proper condition so that it may be used efficiently as to the purpose for which it was originally intended.
Productivity	Ensure logistically, that research, design development, manufacture, and acceptance of material is accomplished within a realistic timeframe and that the confines of standardization, interoperability, contracting, quality assurance, transportability, reliability, safety standards, specifications, production processes, testing, equipment documentation, configuration control, and modifications are all met prior to implementing.
Protection	Preserve the survivability of mission related personnel, equipment, facilities, information and infrastructure either deployed or non deployed within or outside the boundaries of an operational area.

Renewable Energy	Energy resources that is naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include: bio-fuels, biomass, hydroelectric power, geothermal energy, solar energy, wind power, ocean thermal energy, wave power and tidal power.
Security	Measures taken by a military unit, an activity or installation to protect itself against all acts designed to, or which may, impair its effectiveness.
Sustainability	Provide and maintain forces, material and consumables necessary to support the mission.
Transformation	Evolutionary process to make the United States Army run more like an enterprise and better develop and maintain a force in a period of extended conflict demanding sustainable resources.

All terms except renewable energy are from JP 1 - 02 *Department of Defense Dictionary of Military and Associated Terms* 12 April 2001, (as amended through 17 October 2008). Renewable energy is referenced in *Alternative Energy Glossary and Reference Guide*, By Fulbright and Jaworski L.L.P. 2008, p. 28.

ENERGY SUSTAINABILITY AND THE ARMY: THE CURRENT TRANSFORMATION

Chapter 1

Introduction

The Army confronts a fundamental issue as it considers its ability to conduct future missions successfully. That issue is: Does the Army have the capability to continue to sustain the force with oil indefinitely? Does the Army reduce or eliminate existing contingency operations, due to our reduced capability to continue to sustain the force? The successful resolution of this issue may be crucial in determining the scope and robustness of future army capabilities to conduct contingency operations or successfully prevail in force-on-force encounters. A force fueled by petroleum will be subject to vulnerabilities from both political military disruptions and from a failure of sufficient supply. The subsidiary question is: Should the Army continue to be permitted to consume energy at high rates with little effort at conservation?

This paper will explore those issues by reviewing global oil supply disruptions starting with 1973, and the causes for these disruptions. We will follow those disruptions through the most recent price shock to make the case that the Army faces a much greater danger to Army sustainability today than previously. Until our most recent price shock, political military drivers were behind price spikes. This provided two courses of action to reduce operational vulnerability: reduce demand or adjust the politico-military factors that led to the price spike. The thesis of this paper is that the Army is approaching a one-option world: it must reduce the need to consume foreign oil. Political military adjustments will prove insufficient to redress a fundamental failure of supply. This paper will follow initial Army responses to those earlier oil shocks, and the

results of those responses for lessons learned. Then the paper will focus on the Army's latest response to oil price shocks during the past few years. It will evaluate whether today's response bolsters core Army needs, and whether the response will reduce dependence on oil as a source of Army energy needs, particularly for mobility fuel and in-theatre sustainment. The lessons from the earlier Army responses will be compared to the current Army response for lessons learned and recommendations for action. Finally, the paper will examine the wide range of Renewable Energy Systems options for the role they may play in sustaining Army capabilities, and how inclusively the Army is working to incorporate those options. Specific recommendations will be offered to incorporate these non-petroleum options into the Army's energy future.

Now, not only is there a demand and supply issue, but there is also an economic issue, that has strategic complications. The viable alternative would be for the Army to reduce consumption through RES and conservation methods, and continue our efforts in sustaining the force in both contingency operations, as well as CONUS based installations. This paper will examine these issues, starting with the price shocks of 1973 and culminating with recent price shocks starting in 2004. By examining the evolving nature of these oil spikes one will better understand that while in the past the United States had the ability to adjust these oil fluctuations through political or military measures. However, today due to diminishing oil reserves a price shock cannot merely be remedied with politico-military measures, but instead is reliant upon the utilization of RES and conservation.

During the last 38 years, the United States has periodically been challenged by rapid increases in the cost of oil. The first oil price shock occurred in October 15, 1973,

and was the result of the Organization of Petroleum Exporting Countries (OPEC), oil export embargo. Many of the Arab oil producing states participated in this price shock as a response to western support of Israel during the Yom Kippur War. Prices were raised by 17%, to $3.65 per barrel of oil.[1] The second price spike arose in 1979, and was the result of the Iranian revolution. The Shah of Iran fled the country allowing the new regime to control oil exports, but its policies were inconsistent and its production at a lower volume forcing prices to go up. The overall loss in production resulted in driving the price of fuel far higher than would be expected. The third price shock occurred because of the first Gulf War and lasted only six months in 1990. The fourth and existing increase in oil prices began 2003, when the price of oil rose above $30.00 per barrel and reached $60.00 per barrel by August 11, 2005. It continued a steady climb until reaching a precipice of $147.00 in July 2008. There is no definitive answer as how this last spike developed, however most speculate it is either a decline in petroleum reserves, worries that oil will peak and there will not be enough reserves in the future to sustain the economy, tension over the Middle East, or oil price speculation.[2] What characterizes the first three of these spikes is that they were driven by either politico-military factors or both. The United States of America and the U.S. Army responded to each price shock, but as the shock subsided, the good intentions were never implemented. Thus, this resulted in continued strategic and economic vulnerability to the United States.

The distinguishing factor between this most recent price shock versus the previous three, shocks is that this time the demand for oil is exceeding the supply. Previously, the United States had the option of acting to reduce energy consumption, or

to handle the politico-military instability with diplomacy, or war. Currently, the United States may still use conservation as an option; however, renewable energy systems or RES is now, more than ever an attractive option. Today, the United States and the Army is at a crossroads, if it does not avail itself to other forms of alternative energy, the result may pressure a pull back of overseas military operations, due to national economic priorities and constraints. It will also have continued strategic implications for America's dependence on foreign oil in a time of geopolitical instability. Thus, for the purposes of sustainability, as well as national security, the time has come for the United States Army to transform itself, with both CONUS Army Installations, and OCCONUS Forward Operating Bases, to no longer be dependent on foreign oil.

Chapter 2

Background

Price Spikes

Historically the United States has experienced four major oil price spikes. A price spike for the purposes of this paper is defined as a rapid significant price increase which may be accompanied by a shortage of supply.[3] There are several possible causes for a price spike: over usage, aging infrastructure, and bottlenecks at oil refineries and port facilities that restrict fuel supply. An emergency can also occur during cold winters, which leads to oil reduction. Pipeline failures and accidents may contribute to minor interruptions to energy supplies. A spike could also happen after infrastructure damage from severe weather. Attacks by terrorists on infrastructure are also a possible problem for energy consumers. A successful strike on a Middle Eastern facility could potentially cause severe global shortages. Political events may also disrupt oil production and create shortages, such as a change in government, or a military occupation.[4]

First Oil Spike-OPEC

The first oil price spike that occurred in October 15, 1973, was the result of the Organization of Petroleum Exporting Countries' (OPEC) oil export embargo, which consists of Arab oil producing states, responding to Western support of Israel during the Yom Kippur War. Prices rose dramatically in order to reduce the demand and to lower the level of supply. October 16, 1973, the Organization of Petroleum Exporting Countries unilaterally raised posted prices and the price of oil quadrupled to $75.00 per barrel. OPEC oil ministers also agreed to use oil as a weapon, to punish the West for their support of Israel in the war. Thus, they recommended an embargo against

unfriendly countries, and mandated a cut in exports.[5] This embargo lasted until March 17, 1974; however, the action itself prompted President Richard Nixon to sign the Emergency Petroleum Allocation Act, authorizing price, production, allocation and marketing controls on November 17, 1973.[6]

Conservation Measures

The effects of the increase in oil lingered throughout the 1970's and the price of energy continued increasing, while the American dollar began its decline in world markets, fuel was scarce in the United States causing rationing cycles to be put in place. Due to the increased oil prices, and scarcity of fuel, rationing, and conservation measures were enacted by Presidents Nixon, Ford and Carter, to alleviate the pressure on the economy. The first order of business was to assist in reducing consumption, so in 1974 a national maximum speed limit of 55 miles per hour was imposed through the Emergency Highway Energy Conservation Act. In 1975, the United States also began development of the Strategic Petroleum Reserve, and in 1977, the first cabinet level for the Department of Energy was created. This was then followed by the National Energy Act of 1978.[7] The increase in oil prices also led to greater interest in research for both solar and wind power, as well as placing pressure on Congress to exploit North American oil sources and increase the United States dependence on coal and nuclear energy.

Second Oil Spike- Iran

The next oil spike occurred in 1979 and was the result of the Iranian revolution. The Shah of Iran fled his country in early 1979 allowing Ayatollah Khomeini to gain control. The new regime continued oil exports, but it was not consistent and at a

reduced amount. This forced prices to increase.[8] President Jimmy Carter in July 1979 had a fireside chat where he argued the oil crisis was the "moral equivalent of war." He outlined his plans to reduce oil imports and improve energy efficiency in his "Crisis of Confidence" speech.[9] During the speech, he wore a cardigan and encouraged citizens to do what they could to reduce their use of energy. He also installed solar power panels on the roof of the White House and a wood-burning stove in the living quarters. In January 1980, he issued the Carter Doctrine, which declared that an act by any outside force to gain control of the Persian Gulf will be considered an assault on the vital interests of the United States of America and will be stopped by any means necessary, including military force.[10]

Price Controls

President Carter also proposed removing price controls that had been imposed in the administration of President Nixon before the 1973 crisis. These price controls were dismantled in phases starting in April 1979. This Executive Order signed by President Carter allowed market controls to cease and prices to be determined by the free market.[11] Thus, price controls were finally abolished under President Ronald Reagan on January 28, 1981.[12]

Contributing Factors

During the 1980's there was an oil glut, which is a surplus caused by falling demand following the two previous oil price spikes. The world price of oil, had peaked in 1979 at over $35.00 a barrel, collapsed in 1986 from $27.00 to below $10.00 per barrel. This, and energy conservation measures slowed economic activity, causing this

six-year decline that culminated with a 46 percent price drop in 1986.[13] This was also assisted by United States oil price controls ending, and overproduction.

It was during this time that the solar panels were removed from the White House roof, in August 1986 during the administration of President Reagan. The panels were supposedly removed due to a leak, however they were not replaced.

Oil Scarcity, RES, and the U.S. Army

The United States was also concerned about the unavailability of energy, as well as focusing on utilizing other forms of it, and increasing research and development of methods to harness renewable energy as an attempt to respond to both the oil price spikes of 1973 and 1979. Both situations increased public awareness that oil is a limited resource that would eventually be depleted and that the U.S. needed to develop some alternative measures, in that the price of oil would never return to pre 1973 levels. However, apparently few were listening, which was clearly evident within the U.S. Army, which developed its first Army Energy Plan in 1980 and revised it in 1985. The plan laid out goals, objectives and overlying guidance for 10 years and then it appears little was done regarding a plan after the 46 percent drop in the price of oil in 1986. One can only conclude that the military as well as the United States focused upon other issues more important than renewable energy and conservation, once the situation had diminished. Since energy was no longer paramount in the minds of the American public, elected leaders were willing to let the issue languish until the next price spike hit.

Third Oil Spike-Gulf War

Fortunately, the third oil price spike was because of the first Gulf War and lasted only six months in 1990. As Saddam Hussein left Kuwait, the oil fields were set on fire, causing damage and reducing the output until repairs could be made. OPEC decided

that since the oil production in Kuwait was falling, they would increase their oil supply and stabilize the oil market. Oil hit a then-record price $50.50 per barrel, before rapidly falling to about $16.00 per barrel at the end of the War.[14]

Fourth Oil Spike-Insufficient oil

Thus, from the mid 1980's until September 2003 the "adjusted price of a barrel of crude oil was generally under $25.00 a barrel. Then during 2003, the price rose above $30.00 and reached $60.00 by August 11, 2005, and rose above $147.00 in June 2008."[15] U.S. Energy Secretary Samuel Bodman in June 2008 stated that "insufficient oil production not financial speculation was driving rising crude prices. He said that oil production has not kept pace with growing demand and in the absence of any additional crude supply, for every 1% of crude demand, we will expect a 20% increase in price in order to balance the market."[16] During this same period both T. Boone Pickens, the influential oil investor, as well as, OPEC governor, Mohammad-Ali Khatibi said when they were interviewed separately, "that oil prices would hit $150.00 by the end of the year."[17] Oil finally peaked in July 11, 2008 at $147.00 before a decline into the $40.00-$45.00 dollar amount towards December 2008, where the price per barrel completely bottomed out.[18]

Price Shock

The first year that the United States realized we were in a new era of global energy supply and demand was 2004. What happened in 2004 was the world's first demand-led energy shock. This was the result of long-term trends that pushed demand well ahead of supply, stimulated by increased demand in oil from China. Other than wars, whenever the crude oil market became tight, shortages could be garnered

through spare crude oil capacity, spare refining capacity, or spare discretionary oil product inventories. These three reserves were the shock absorbers for the world oil market and as oil demand continued to increase at approximately one percent per year, these shock absorbers would alleviate that gradual fluctuation ensuring that prices increased gradually. Unfortunately, in 2004, two things happened: all that spare crude was gone and demand for energy continued to increase. Part of this was due to China. The International Energy Agency predicted that global demand for crude oil would grow by 1.5 million barrels a day; instead it grew by three million barrels a day. Normally high prices would stir investment, drilling, and oil. However, this time there was a shortage of equipment in the oil industry, and skilled petroleum engineers to expand production. Additionally, countries like Russia began to eliminate foreign producers to pump more oil for themselves. This discouraged others from operating and reduced production.[19]

Global Energy Crisis

Thus, the difference between 38 years ago and the situation today is that the United States can no longer be dependent upon foreign sources for their oil as they have done in the past and deal with these periodic price spikes. While the United States could still handle the politico-military fall-out, there is just not enough oil worldwide to be completely dependent upon our foreign subsidiaries. During the 1970's the phrase "independence from foreign oil" became common term. We started paying attention to how much oil was imported each year. We continued this process, as oil imports increased from 34% in 1973 to 60% in 1983.[20] Former Presidents, members of Congress, elected officials, and subject matter experts have previously touted that the U.S. needed to reduce its' dependence on foreign oil and that our

continued dependence is irresponsible. Every President since Richard Nixon has discussed our nation's dependence on foreign oil, yet that dependence has continued to increase for almost forty years.[21] According to Amory Lovins, the experimental physicist who heads the Rocky Mountain Institute, "if the United States had continued into the 1990's to conserve oil at the rate it did in the period from 1976 to 1985, thanks in a large part to the improved mileage standards, it would no longer have needed Persian Gulf oil after 1985."[22] Unfortunately, all of these noteworthy individuals' opinions have been ignored. It now appears we have yet again come full circle, where many of the policies of the 1970's, and plans of the 1980's will have to be reexamined for possible revision and implementation. Thus, the quote "Those who refuse to learn from the past are condemned to repeat it,"[23] could never be more accurate.

Chapter 3

Army Energy

Historically, the United States Army had not one but two Army Energy Plans, which would forecast its goals and objectives into 2000. Thus, it is important to examine the intent, goals and objectives of both the 1980, as well as the 1985 plans, in order to discover what the Army said it wished to accomplish, and whether the Army is now on that same road, with different leadership. Additionally, the Army may have moved beyond the 1980's, and recommended innovative RES, and conservation solutions with the advent of the Army Energy Security Implementation Strategy.

Army Energy Plan-1980

The 1980 Army Energy Plan "identified current and long term objectives and goals for the Army. It summarized those existing and new Army programs, which would be necessary to accomplish those goals and objectives. Energy consumption and costs were projected to the year 2000."[24] In the introduction to the plan by United States Army Chief of Staff, General E.C. Meyer, he notes that "the Army has reduced its energy consumption more than 29% since 1973 and nine and one-half percent since 1975, yet it is important that we continue to manage our energy resources efficiently to reduce our vulnerability to limited external resources and enhance our ability to meet our national security obligations."[25] It is apparent that the Army made major headway in reducing energy consumption. Much of this was due to conservation measures. The report also mentions that the Department of Defense was able to save more than 22% during a six -year period. However, the report was quick to note, "DOD consumes 1.85 percent of the nation's energy and 2.5 percent of the total petroleum."[26]

Army Advisory Group

The Army Advisory Group on Energy adopted some goals and objectives which they defined as “ambitious and far reaching”. The goals were revised in October of 1979 and include the following:

- “Reduce energy consumption by 35 percent by the year 2000.
- Reduce energy consumption in facilities operations 20 percent by FY85 from the FY 75 consumption level and an additional 20 percent for a total of 40 percent by the year 2000.
- Reduce dependence on nonrenewable and scarce fuels by the year 2000.
- Develop the capability to use synthetic gases to reduce the dependence on natural gases; reduce the use of natural petroleum fuels in facilities operations 75 percent by the year 2000.
- Develop the capability to use synthetic or alternate fuels for mobility operations petroleum requirements by the year 2000.
- Increase efficiency of nonrenewable energy dependent mobility systems 15 percent.
- Achieve the above goals without degrading the readiness of the force.”[27]

Conservation Measures

The Army had a plan in place for conserving energy by reducing heat and cooling temperatures, increasing insulation, keeping windows and doors closed, reducing lighting, consolidating activities, reducing water temperature levels and fine tuning equipment for better efficiency. This was how they were able to conserve so much energy for the past as denoted previously at the facility level; however, it was one thing to save 20 percent at the facility level, and another thing to accomplish 40 percent. The

report stated that in order to accomplish this goal of 40 percent reduction in energy consumption in facility operations, the Army would have to conduct Energy Engineering Analysis Programs, and testing alternate sources of energy such as solar, biomass, and refuse-derived fuel. The report indicated that by the year 2000 that approximately 17 percent of the Army's property would be replaced with new buildings which are more energy efficient.[28] Coupled with this statement, the report mentions wanting to explore the "utilization of electric powered vehicles to the maximum extent for administrative purposes, as well as the use of synthetic fuels."[29]

Organizational Structure

The 1980 Army Energy Plan also laid out an organizational structure for energy, which consisted of a Special Assistant for Energy, located in the Office of the Assistant Secretary of the Army for Installations, Logistics, and Financial Management, the Deputy Chief of Staff for Logistics, and the Advisory Group on Energy and the Army Energy Office. Each one of these entities was given specific responsibilities that are similar to the current organizational structure that was recently agreed to by the Secretary of the Army. "The Special Assistant for Energy is a designated position on the staff of the Secretary of the Army. The responsibilities are to represent the Army on the Defense Energy Policy Council, to implement those tasks and initiatives from the council, and to monitor the Army Energy Program."[30] The Army Energy Office also has a direct coordinating relationship with the person who occupies this position.

> "The Advisory Group of Energy was organized in April 1975 under the authority AR 11-27 with a requirement of lieutenant colonel or civilian equivalent for the purposes of membership. The group eventually was elevated to general officer

status, due to the recommendations of an energy management study. The Director of Transportation, Energy and Troop Support of the Office of the Deputy Chief of Staff for Logistics chaired the group. The Secretary was the Chief, Army Energy Officer."[31]

The group had the responsibility of reviewing Army policies, programs and procedures for their impact on energy and recommended corrective action; providing a forum and determining actions to attain presidential, national or Department of Defense established goals for energy conservation; and developing and providing recommendations on energy issues.

The Army Energy Office

The Army Energy Office was established 23 November 1973. The office was located in the Directorate for Transportation, Energy and Troop Support. The office was responsible for:

- "Supervising and coordinating The Army Energy Program.
- Formulating and recommending Department of the Army policy for the allocation, supply, and use of energy resources within the Army;
- Developing and executing a comprehensive energy conservation program; providing principal Army staff advisers and contacts on energy related matters to the Office of the Secretary of Defense, Office of Management and Budget, the Congress, other military and government departments, and the civilian sector
- Participating in the budgetary process for the Army Energy Program within overall guidance and policies developed by the Director of the Army Staff and the Comptroller of the Army."[32]

This model, served as the basis for the entire organizational structure for energy, and has now come full circle with the advent of the 2008 Defense Science Board Report, the Army Energy Task Force and the positions of responsibility in the Senior Energy Council, and Senior Energy Executive.

Army Consumption

One item that the Army discovered as evidenced in the report, is that it is easier to target conservation, investment, and research and development efforts into facility operations in order to reduce the total consumption of Energy of the Army, rather than to focus on RES for operational issues. The Army Energy Report for 1980 did take into account that the "Army's share of DOD energy consumption was 18 percent, and of that amount, 84 percent was consumed in installation or facility operations and 16 percent in mobility operations."[33] In 2007, during wartime, the facility to operational use ratio is almost reversed Army installations representing the largest energy end-user of 67% during Peacetime and 37% during Wartime.[34] Since it is easier to affect consumption on Army installations rather than operations, the Army is especially challenged to reduce its energy consumption during wartime. This increases the need for the Army to address the conservation levels at the installation level due to the higher operational consumption rate during wartime.

Installation Strategy

The Army Energy Plan for 1980 did suggest both a short and long-term Installation Energy Systems Strategy, as well as an Installation Energy Conservation Strategy. The Short Term Systems Strategy focused on, procuring, operating and maintaining solar energy systems; procuring and accepting specifications for production

and use of synthetic fuels; and the operation and maintenance for wind energy equipment.[35] "The Long Range Program, which was identified as FY 89-97, focused on such issues as: procedures to use hydrogen as a fuel at military installations; procedures for use of geothermal and photovoltaic energy systems; planning and design criteria for synthetic fuel heating plants; and planning and design criteria for fuel-cell energy systems."[36] Both strategies were forward thinking. Thus, with the Army Advisory Energy Group's initial goals previously outlined, one can make the assumption that the Army believed that it could reduce energy consumption in facilities operations 20 percent by FY85 from its FY75 level, further an additional 20 percent total of 40 percent by the year 2000, by utilizing conversation measures, and beginning their foray into synthetic gases, alternative fuels, and other forms of RES.

Research and Development

The Army Energy Plan of 1980 also included a far reaching recommendation for research and development in that , The Army would develop multi-fuel engines capable of operating on multi-source fuel; modify or select automotive engine lubricating oils and other fluids for use with alternative fuels, and encourage the Army to support funding, energy programs, particularly alternative fuels, fuels and lubricants engine development, and material development.[37] This indicates that the Army had the foresight to realize it should not continue to be dependent on oil as the only source of energy, especially knowing that the engines to power all of the equipment ran on only two types of fuel, which was costing DOD, the Army and the American taxpayer, millions of dollars to support. One must realize that the authors of the report had the foresight to realize that the cost of fueling the force, from a facility standpoint, much less

a mobility standpoint would be even more costly in the advent of War. While it is doubtful many could have forecasted the increased cost of the Persian Gulf War, as well as Operation Enduring and Iraqi Freedom, it is enough to suggest that the Army was advocating for change particularly in the usage of alternative fuels.

Army Energy Plan - 1985

The 1985 Army Energy Plan does further solidify the recommendation to utilize RES and alternative forms of fuel. Regarding facilities, energy goals there are a few additional suggestions such as two in the short-range goals category, "30% reduction in use of petroleum based fuels, and 15% of facility energy derived from solar, coal, RDF and biomass fuels."[38] Additionally, there is an all-encompassing major goal for long range facility operations which suggests "reducing use of petroleum fuel by 75 percent through a combination of: absolute reduction in energy consumption; conversion to solid fuel coal, biomass and RDF; conversion to renewable energy sources solar, geothermal and wind; and conversion to synthetic liquid fuels."[39] Furthermore, the 1985 Energy Plan re-fueled and extended the goals of the 1980 Army Energy Plan to 2000.

Facility Operations

The 1985 Energy Plan acknowledges that drastic measures would be needed in order to meet the overall goals of a 40 percent reduction in energy consumption and 75 percent reduction in use of petroleum fuel by the year 2000. Thus, the Army recommended some key areas of development in both construction and utilities to meet the goals. They made the following recommendations for construction: "increased use of underground construction; increased use of multiple-use facilities; decreased facility

energy loss; increased use of total energy and selective energy system."[40] Regarding the usage of utilities, the plan suggests:

- "Filtering and recirculation of air.
- Reclamation of waste energy.
- Use of solar energy for heating, cooling, and domestic and process hot water needed to service buildings.
- Use of biomass and RDF as a fuel supplement or as a primary fuel.
- Use of nuclear energy for military facilities.
- Use of coal as the primary energy source for military facilities while meeting. environmental standards.
- Increased utilization of heat pumps, metering of all facilities to include family housing.
- Implementation of a four day, 10 hour per day, work week.
- Use of geothermal energy for heating and cooling.
- Use of wind-driven energy for heating and cooling.
- Increased utilization of coal and biomass gasification."[41]

Thus, the long-range outlook for facilities was extremely forward thinking and it included many valuable suggestions to assist the Army in meeting these ambitious goals.

Joint Initiatives

The 1985 Army Energy Plan can be differentiated from the 1980 Energy Plan in that the 1985 plan also discussed joint initiatives between the Departments of Energy and Defense in that through a joint working group they were able to identify initiatives that could be jointly undertaken. There were several initiatives that where entirely within only the Army's purview: "photovoltaic development and utilization; solar heating and

cooling for buildings; wood-fired central heating plant; pyrolysis plant for conversion of wood to liquid fuels; synthetic mobility fuels; and coal/water slurry as a fuel."[42] The impetus of this joint initiative has continued past the year 2000. Specifically, DOE still engages in a number of joint initiatives with DOD and it is often consulted on energy projects where both parties have shared goals and can benefit fiscally and in other ways, by combining their resources and working together toward common goals.

Army Metering System

The 1985 Army Energy Report added a new Army metering system installed on family housing units at three active duty installations.

> "A total of 4,008 electrical and fuel meters were installed in 2,494 family housing units at Fort Eustis, Fort Gordon, and Yuma Proving Ground. This test program was to establish base data for energy consumption in family housing and the problems associated with meter reading, maintenance and billing were analyzed. The program was initiated 1 January 1979 and a report on the program was submitted to Congress in March 1980."[43]

The importance of this initial program cannot be underrated, since it has served as the impetus for the Army Metering Program at all Army Installations, and is the primary mechanism for the Army to assess utilization of electrical consumption at each base of operation. It is also the reason why the recently formed Army Energy Security Task Force is currently advocating the metering of every building on every Army Installation.

Chapter 4

DOD and Energy

Defense Science Board

Since 1997, numerous laws, executive orders, and DOD and Army guidance have attempted to direct the path to reduce the usage rates of energy by the Army in an effort to reduce our consumption of foreign oil. The Defense Science Board had two different Energy Task Forces, one in 2001, and the second in 2008. Many of the same recommendations made by the first task force were promulgated by the second task force since those ideas were never implemented by the DOD, however the final report of February 2008 pointed out that the DOD faces two primary energy challenges: expensive and greater fuel demand for contingency operations, which may compromise our operational capability and jeopardize mission success; and critical missions at military installations are vulnerable due to loss from a commercial power outage and inadequate backup power supplies.[44] The Defense Science Board (DSB) Task Force of 2008 was composed of 77 members who "divided into four panels to examine policy issues, combat platforms, facilities and infrastructure, and research and technology."[45] The group met from May 2006 to March 2007, and conducted 37 meetings, 143 briefings, examined numerous studies and held many discussions to arrive at its recommendations. The report reflects the assessment of the panels and deliberation of the entire Task Force. The overall report "reinforced the findings of the 2001 report "More Capable War fighting Through Reduced Fuel Burden", that DOD's fuel-related problems are in a large part the consequence of poor business practices."[46]

> "The Department of Defense is the largest single consumer of energy in the United States. DOD spent 13.6 billion in 2006, to buy 110 million barrels of oil,

> and 3.8 billion kWh of electricity. This represents 0.8% of total U.S. energy consumption and 78% of energy consumption by the Federal government. Buildings and facilities account for about 25% of the Departments total energy use, and DOD occupies over 577,000 buildings worth $712 billion at more than 5,300 sites. This same year the Department spent over $3.5 billion for energy to power installations, and over 10 billion on fuel for combat and their related systems."[47]

Coupled with these figures almost all of the electrical energy, which DOD utilized for its CONUS facilities, is derived from commercial carriers. Many of these grids are brittle and are having enough trouble supporting the nearest town's infrastructure without having the increased burden of an Army Base tapping onto the system.

Fully Burdened Cost of Fuel

One recommendation of the DSB Report regarding fuel efficiency that was ignored following the original 2001 report, was readdressed in the 2008 report as a recommendation that was endorsed in a memorandum on 17 August 2006 by the Vice Chairman of the Joint Chiefs of Staff, who recommended a Joint Requirements Oversight Council to establish an Energy Efficiency Key Performance Parameter, and also on 10 April 2007 another memorandum establishing department policy to use the fully burdened cost of fuel for all acquisition trade analyses.[48] The importance of this recognition by the military community was that utilizing battlefield operating systems to deliver fuels by convoys from point A to point B creates a tremendous logistics "tail" that places usually more than 100 soldiers into harm's way transporting fuel. Taking these factors into consideration, the true cost of fuel includes: the original cost of the fuel, the delivery, the vehicles used for delivery, and the fuel they expend, the cost of the soldiers or contractors that transport the fuel, and the cost of protection from additional security forces of soldiers on gun trucks, as well as the risk for potential casualties. When you

factor in all these hidden costs "the fully burdened cost of delivering a gallon of fuel in the Iraqi military theater was at least $20 a gallon, and for many missions went upwards of hundreds of dollars per gallon for ground forces."[49]

Brittle Power

The concern of the DSB regarding the brittleness of the electrical supply system to CONUS is not a petroleum price sensitive issue, but an important and related issue that directly relates to the ability of the Army to operate effectively. Thus, the DSB saw the relationship and recommended dealing with both national security issues: petroleum and brittleness. Therefore, both issues must be considered together in order for the Army to issue a comprehensive response to energy uncertainty.

Less than 1% of Army installations are self-sustainable with backup power plants, which could generate electricity. Thus, since virtually all of these facilities draw their power from off the commercial electrical grid, it places these installations at even greater vulnerability if the United States would sustain an attack on its' electrical grid system from inside the boarders of our country. How would the U.S. military respond if their own electrical supply were under attack? The book Brittle Power co authored by Amory Lovins, and L. Hunter Lovins was written in 1982, however the premise of the book that America's energy system is brittle, and highly susceptible to an attack from inside or outside its borders by terrorists, insurgents, who could sabotage any of our internal energy supplies be it oil pipelines, liquefied petroleum gas, nuclear power plants, electrical power stations and substations, is as relevant today. The Energy Task Force, familiar with the Lovins' work, recommended that DOD pursue the concept of islanding which would isolate critical loads, and selectively entire Army installations,

from the electrical grid making them self sufficient.[50] This would be a step towards making the military more independent, so that they are able to protect themselves as an entity, especially if they are called to perform various Homeland Security Missions, due to natural disasters. The move toward islanding and local generation systems can reduce the brittleness of the electrical grid, and increase our energy system to enhance our national security.

Lack of Leadership

The bottom line of the DSB Report however, was that DOD had a lack of leadership and that was the primary problem behind the militaries energy issue.[51] While this observation can be addressed in many ways, one of the overlying themes of this paper is the fact that leadership is the cornerstone of accomplishing any of the energy goals and objectives delineated by the Army Energy Security Implementation Strategy. If the military does not place the right people, at the right place, at the right time, in positions of authority, can make decisions and be held accountable for the results, the Army will continue to depend on foreign fuel, and the Defense Science Board, and any efforts expended by other entities no matter how valiant will again be fruitless.

Army Leadership

Shortly after the results of the DSB Report were made public, Secretary of the Army Peter Geren issued a 15 April 2008 memorandum ordering the creation of the Army Energy Security Task Force, with the following objectives: “Reduce Army energy consumption; increase energy efficiency across platforms and facilities; promote the use of new sources of alternative energy; establish benchmarks for the Army’s

environmental footprint; and provide guidance for the creation of a culture of energy awareness across the Army."[52]

Secretary Geren designated the Office of the Assistant Secretary of Installations and Environment to oversee the task Force and develop a strategic action plan. Additionally, the task force was asked to develop framework for all Army energy security efforts. Deputy Assistant Secretary of the Army Paul Bollinger was named as the Task Force leader.[53]

Secretary Geren gave the Task Force 60 days to complete their work and expected recommendations on 19 June 2008. This required a Herculean effort and so for the next 60 days the Task Force split down into several Focus Area Work Groups that met 30 times to develop information papers and recommendations, and the entire task force had "15 regular meetings with Headquarters of the Department Army Staff and subject matter experts to discuss progress and resolve issues. It was hoped that these recommendations would provide Secretary Geren the requisite information in order to make policy decisions concerning the future energy posture of the Army."[54]

Secretary Geren was then briefed by the task force on 19 June 2008, and as a result of that briefing "established an Army Enterprise Energy Initiative, and directed the Assistant Secretary of the Army for Installations and Environment to lead the newly formed Army Senior Energy Council to develop and execute a future Army Enterprise Strategy, and to work toward securing the Army's energy future. The Deputy Assistant Secretary of the Army for Energy and Partnerships was then designated as the Senior Energy Executive, and would serve as the Director of the Security Energy Council."[55]

Also after this briefing, Secretary Geren approved seven recommendations that the

Task Force suggested, as well as several specific action items to initiate their implementation. Shortly thereafter, several Army energy initiatives were identified to highlight the types of projects that exemplified the Army's new approach to energy planning. Additionally the fully-burdened cost of fuel was recognized and identified as a mechanism to be used in all Army analysis. The seven recommendations were:

- "Establish the Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships, responsible for development of an Army Enterprise Energy Strategy.
- Establish a Army Senior Energy Council, with the above as Chairman; accelerate use of renewable energy sources to increase energy security in a cost effective manner.
- Expedite utility metering at all installations to reduce consumption and increase efficiency.
- Implement practice and technologies to control Forward Operating Base energy accountability and reduce consumption.
- Certify Army platforms for alternative fuels to ensure operational fuel supply.
- Implement acquisition and procurement practices requiring efficient power and energy solutions."[56]

Army Energy Initiatives

Secretary Geren was again briefed on 22 July 2008 by the Army Energy Security Task Force on five Army Energy Initiatives that were on-going project proposals. Each initiative was briefed providing a project description, the amount of time required by the Army as an investment, the benefit to the Army and the status of the project. There was

also a slide of preliminary environmental considerations. This briefing was then substantially increased to be given in more detail to Secretary Geren on 21 August 2008. This time each initiative or project also had a cost benefit slide including an overall Cost Benefit Summary Slide, including all of the initiatives. These briefings provided the Secretary of the Army a one over the world overview for those projects that the Army was currently working on, what their status, was, how much they were going to cost, what the benefit was to the Army, how much time it was going to take, and if there were any assumptions which needed to be considered. The importance of this was paramount because on 6 October 2008 Secretary Geren did a press release announcing these projects, which was one of the decisions that the Army Energy Security Task Force asked him to make when they briefed him on 19 June 08 and requested that he announce a model for renewable energy projects such as solar, wind geothermal, biomass within 30 days.[57] While the period was approximately eleven weeks off, it was still accomplished and part of the original timeline established by the Task Force.

Army Senior Energy Council Charter

It was on 6 October 2008 at this press conference that Secretary Geren announced the approval of the creation of the Army Senior Energy Council for which he signed the charter on 26 September 2008.[58] The council was tasked to develop a strategy for approval by the Secretary of the Army, an Army Enterprise Energy Strategic Plan in three years. What the charter states is that the plan shall:

- "Synchronize energy program resource requirements with the Army Planning, Programming, Budget, and Execution process and timeline.

- Provide guidance for the development of Army power and energy priorities and implementation plans.
- Promote integration of power and energy strategies for installations, weapon systems, and contingency operation base camps.
- Leverage innovative technologies for alternative and renewable energy.
- Provide metrics for monitoring progress of programs and operations intended to facilitate the accomplishment of the plan's goals and objectives."[59]

Chapter 5

The Way Ahead

Army Energy Security Implementation Strategy

The Army Energy Security Implementation Strategy, (AESIS), was approved by the Army Senior Energy Council on 13 January 2009. The document presents the Army's energy security vision, mission, and goals, and describes the framework of the Senior Energy Council to address energy security which is required by the original charter.[60] The mission of AESIS, is to "make energy a consideration for all Army activities to reduce demand, increase efficiency, seek alternative sources and create a culture of energy accountability while sustaining or enhancing operational capabilities."[61] The Army Energy Security Vision is divided up into three categories, shaped as a triangle in which leadership forms the pinnacle, the middle is represented by partnership, and ownership provides the base. The strategy describes leadership as being Army commands, accountable for energy by providing incentives for innovative solutions. Partnership is described as organizations internal to the Army, joint services, the Department of Defense, federal agencies, and the private sector all benefiting from accomplishing the mission. Partnerships with the private sector are identified as having the greatest potential to enhance energy security and to generate revenues if alternative financing is utilized.[62] These partnerships would be particularly useful regarding alternative and renewable energies on Army facilities and installations. The foundation of this vision is ownership in which knowledge, training, and operational awareness of the importance of energy to all aspects of the Army mission is impressed upon a Soldier the minute he/she is inducted into the Army.[63] It is these three layers of vision

combined with mobility, logistics, acquisition, research development, testing, evaluation, infrastructure and training, which are going to serve as the cornerstone of deploying the Energy Strategy.

Senior Energy Council – Working Groups

While the Senior Energy Council will set the overall energy security strategy, and goals for the Army through the development and revision of the Army Energy Security Implementation Strategy, working groups, consisting of designated representatives, at least at the level of Colonel, are actually the foundation of the Senior Energy Council and will ensure a direct linkage between the working groups activities, the SEC principals and their organizations. Subject Matter Experts in areas such as installations and infrastructure; mobility fuel logistics, acquisition, procurement and technology, and contracting may be added to form cross-functional teams. An initial task of the working groups will be to identify by spring of 2009 objectives to guide the development and implementation plans towards achieving the outlined goals. The working groups will assess the alignment of strategic goals and present a summary of this assessment to the Senior Energy Council Advisory Board prior to the summer 2009 SEC Meeting.[64]

Strategic Energy Security Goals

The Army Energy Security Council identified five Strategic Energy Security Goals when they were drafting the Army Energy Security Implementation Strategy. The council believed that the goals "will effectively maintain and enhance operational capabilities, achieve long term cost savings, and strengthen the ability of the Army to fulfill its' mission."[65] Each of these five goals has a definition attached, so it is important to examine both in order to make a critical assessment of whether the Army is

essentially on the right track implementing an Army Energy Security Policy. The First Goal is: "Reduced Energy Consumption, which means to reduce the amount of power and fuel consumed by the Army at home and in theatre. This goal will assist in minimizing the logistical fuel tail in tactical situations by improving fuel inventory management and focusing installation usage on critical functions."[66] The next goal is to: "Increased Energy Efficiency Across Platforms and Facilities, in this way the Army is expected to raise energy efficiency for generation; distribution, storage, and end-use of electricity and fuel for system platforms, facilities, units and individual Soldiers and civilians. This goal also relates to the productivity of a system based on energy requirements."[67] The next Energy Security Goal, which may be the most important, and has the most potential for achieved success is "Increased Use of Renewable Alternative Energy, the intent of this goal is to raise the share of renewable/alternative resources for power and fuel use which can provide a decreased dependence upon conventional fuel sources. This goal also supports national goals related to renewable/alternative energy."[68] The fourth Energy Security Goal is "Assured Access to Sufficient Energy Supply, which is an effort to improve and maintain the Army's access to sufficient power and fuel supplies when and where needed. Energy is a critical resource in conducting Army missions. Vulnerabilities to external disruption of power and fuel sources should be minimized and the potential for industry partnerships to enhance energy security and generate net revenues should be considered."[69] The last Energy Security Goal is "Reduced Adverse Impacts on the Environment, which means to reduce harmful emissions from energy and fuel use, and conduct energy security activities in a manner consistent with environmental and sustainability policies."[70]

Responsibility for meeting these daunting goals is shared across the Army, however "it is the role of the Offices of Primary Responsibility: Headquarters Department of the Army, Army Commands, Army Service Component Commands, Direct Reporting Units, and Field Operating Agencies, to develop and execute implementation plans that include activities to achieve those goals."[71] This will not be possible until the working groups identify objectives and metrics to guide the development of these plans by the Office of Primary Responsibility toward achieving the original goals outlined. This task should be accomplished by the Spring of 2009, so that "the working groups will then be able to take the goals, objectives, and align them with Office of Primary Responsibility implementation plans and present a summary of this assessment to the Senior Energy Council Advisory Board prior to the Summer 2009 SEC meeting."[72] In addition to the goals and a plan to begin them, the Army decided to implement a series of strategic initiatives to jump start their efforts to improve its' energy profile. The next chapter of this paper will outline each of the current Army initiatives regarding energy.

Chapter 6

Discussion of Current Army Energy Initiatives

Reduce Usage of Fuel on FOB's

Generators on FOB's use petroleum based energy. Thus, delivering petroleum to the FOB is a security concern for which long logistical supply lines must be protected from attack. If FOB's are properly equipped and powered to reduce the energy consumption, this would in turn reduce the fuel usage, which would result in fewer supply convoys.[73]

Repeatedly attention has been given to the fully burdened cost of fuel regarding contingency operations. Much discussion on the topic was raised by the Defense Science Board, as well as other authors who have written about the topic. Marine General Richard Zilmer who in July 2006, as Commander of coalition forces in western Iraq, made a priority 1 request for renewable energy systems at outlying bases in order for Marines, Soldiers and Sailors to not intentionally be placed in harm's way and reducing the number of casualties from resupplying convoys with fuel when renewable energies such as solar and wind could be utilized.[74] While it is important to remember that whatever RES the Army would chose to use during contingency operations, has to be affordable, productive, sustainable and maintainable, there comes a point in time when what General Zilmer, stated must bare merit. The plea continues to be heard from too many sources that the time has come to foam the tents, and field tactical hybrid electrical power systems, that would minimize fuel consumption, and reduce the burden on the Service member to haul this fuel.

When the Army Energy Security Task Force briefed Secretary Geren on the Army's Energy Initiatives and Project Proposals, on 21 August 2008, one of the initiatives is to expedite spray foam insulation for tents for theatre. This will be a 37 Million dollar initiative to spray foam insulation on fixed tent facilities throughout central command theatre, (Afghanistan, Kuwait, Djibouti, and other locations), in order to reduce cooling and heating demand which produces fuel savings, and also enhances temporary living, office and operational facilities with stay behind energy efficient structures. Additionally, these insulated tents will reduce noise, and dust, which enhances the quality of life for the deployed Soldier. After completion, this is reported to benefit the Army by saving 70,020 gallons of fuel a day, which would be $341.2 Million dollars a year saved at the fully burdened cost of fuel valued at $13.35 per gallon. This is estimated to save a total of 1.7 Billion dollars over a five year period and the contract began 28 July 08.[75] Obviously while there is a significant cost associated with this initiative, the savings for the Army far outweigh the start up cost.

Army Metering Program

There was some discussion regarding how utility metering will assist the Army since, metering will not in itself save energy. However, it will provide managers the ability to understand energy consumption, and assist in energy investments and decisions to be made at installations, as managers are better able to understand where to focus their attention. Metering consistently comes up in topics of discussion as one of the easiest things that the Army could do to monitor its' installation usage of energy. It was discussed by both Mr. Paul Bollinger Jr. Deputy Assistant Secretary of the Army for Energy and Partnership, and by Mr. Don Juhasz, who is a technical subject matter

expert from OACSIM, at the Army Energy Forum held on 17 November 2008. It was later discussed again that same day as one of the top 10 ways that the Army could conserve energy in its installations as a result of a concurrent working group session on Energy Efficiency and Demand Reduction from the Army Energy Forum on this same date, and LTG Robert L. Van Antwerp, Jr. Chief of Engineers, Commanding General United States Army Corps of Engineers, stated that "we must have everything metered by 2012", when he spoke at the Association of the United States Army on 7 October 2008.[76]

One initiative that the Army is currently vested in is a project for an Army installation to engage in an Energy Management Partnership with Private Industry where a company through competitive contract would manage the Energy Program on a large installation including metering, auditing, and energy reduction projects and after two years a comparison would be made with a similar installation that was not being managed by an Energy Savings Company to determine performance, costs and lessons learned. The potential for the Army was to achieve greater energy efficiency resulting in reduction of consumption to be in compliance with Federal mandates. On 13 January 2009, the Energy Management Partnership was briefed to the Senior Energy Council that Installation Management Command has chosen Fort Leavenworth, KS, as the pilot garrison, and forecast awarding the contract by the 1st quarter of 2010.[77] While this does not answer the argument of metering every building at every Army Installation, it is a first step at risking the affordability of investing in energy conservation, which could yield a more sustainable and maintainable energy efficient facility.

Micro-grids and intelligent power distribution systems CONUS/OCONUS

There has been some discussion regarding the fielding micro-grids and intelligent power distribution systems at Forward Operating Bases, as well as in CONUS based installations. This would require leveraging private sector investments and developing partnerships with private industry. It was also suggested the Army develop the proper policy and procedures for implementing the new technology.[78] While islanding has already been mentioned as a concept worth pursuing for CONUS installations to avoid the potential for an internal security disaster with the national electrical grid, it is equally as critical that this concept and the use of RES systems as a possible back-up resource at OCONUS installations be strongly considered. These facilities are located in less reliable, more vulnerable, more poorly maintained, areas of our world. The OCONUS installations supporting contingency operations usually rely on a single commercial power feed, and few installations can generate enough power on their own to meet mission. Thus, their backup plan is the same as in CONUS which is "a series of diesel generators designed for limited run-time, with short-term on site fuel storage, and not networked to provide a continuum of support in the event they fail."[79] These facilities need to become just as resilient if not more so on renewable energies, such as solar, wind and biomass, which may offer greater continuity of mission, and allowing Military personnel to be more self sufficient. While it is easy to advocate usage of RES and fielding of micro-grids and intelligent power distribution systems, perhaps the safer route would be to ensure through productivity standards micro-grids, power distribution systems, and RES are operable in CONUS, first before they are advocated in contingency base operations.

The Army and Navy are in fact cooperating to test geothermal power generators. The results could provide insights into micro-grid generation based on military generated RES. The Army is beginning the installation of a 30MW Power Plant powered by high temperature hot water, (geothermal) at Hawthorne Army Depot, NV. This project for which funding is coming from service sources including the Navy Geothermal program Office following a similar model at China Lake and the plan construction is being accomplished through 3rd party financing at a cost of $90 million dollars, and would benefit the Army by providing 30 MW of on site, electricity generation from renewable energy; 20 MW supporting the facility providing 24/7 energy security, and 10 MW which may be sold back to grid, generating revenue for the Army of approximately $700,000.00 per year. The drilling was awarded in May 2008 and the plant should be operational 2013.[80]

More insight in to micro-grid distribution and an opportunity to test intelligent power distribution may be provided by a Renewable Solar Energy initiative at Ft. Irwin, CA. This project involves the Army leasing solar systems capable of generating between 150-300 MW of renewable power. The balance of the capacity will be distributed to the grid. The investment is estimated at $300,000 for the initial year and $100,000 for oversight. The benefit to the Army is that this renewable energy project can provide savings as much as $22 million dollars over 20 years. The renewable system would provide energy to the installation and surrounding communities during a regional grid failure. The Army recently started this project in December 2008, with an estimated operational date of the fourth quarter of 2015.[81]

Thus, the Army is continuing to move toward productivity, with both a Geothermal and Solar initiative. While both piloted projects are in the United States, it is premature to advocate demonstration of micro-grids and intelligent power distribution systems in a contingency operations environment. While it is easy to advocate usage of RES and fielding of other systems it is often difficult to garner the support of testing those systems in a hostile area, where the affordability is great, and the productivity is still being ensured. Obviously, third party sources and private industry would have some input as to the timeliness and suitability of such a decision. Since we are so uncertain of the productivity, we could not even consider the sustainability or maintainability of these systems presently in a theatre of operations. While the criteria of affordability, productivity, sustainability, and maintainability, will all come into question, again by investing in RES, the protection of military and civilian personnel living and working on these FOB's, can never be questioned. Every effort should be made to forecast demonstration of a micro-grid, intelligent power distribution system, or testing of perhaps geothermal or solar initiatives after they first have been properly vetted at CONUS based installations.

RES at FOB's.

The use of RES or alternative fuel sources at FOB's will increase energy security as the logistical supply chain is reduced, and less petroleum products are necessary to operate generators. Additionally, if RES is augmented with power systems this will allow alternative and renewable energy sources to be utilized to the fullest potential. There are challenges associated with incorporating renewable/alternative energy. RES is not always available and technology storage is not well developed. Furthermore,

there is a challenge as solar panels or windmills will need to be mobile and placed into FOB operations, but also able to withstand variable weather conditions. Technology is advancing in that RES/alternative sources need to be incorporated to augment FOB power systems.[82]

While this paper previously discussed the potential use of RES at FOBs in order to reduce problems with the commercial grid in contingency operations, it also discussed that some of the potential use of these RES such as solar, wind, and biomass may not yet be suitable for contingency operations. Perhaps in order to determine their productivity they would also best be tested for standardization, interoperability, quality assurance, transportability, reliability, safety standards, product processes and modifications, at a site virtually geographically comparable by climate to that of the area considered for contingency operations. By testing solar, wind, and biomass at Army Installations in CONUS first, the Army would be able to work out all the productivity concerns to ensure the RES is sustainable, and maintainable before engaging in the affordability of taking it OCONUS, where we already know that it would offer a back-up strategy for protection purposes if all these other capabilities were met.

Brigadier General Dana J. H. Pittard, discussed how he fielded tests to foam tents to make them more energy efficient, and reduce generators, up to 80% and carbon emissions by 67%. He also mentioned how he is considering doing eight FOB's which would cost 105 million dollars, but would pay for itself within six NTC rotations or four and one half years. This initiative, as well as using other types of RES, he stated has allowed NTC to use renewable energy at a rate of 4% and reduce energy consumption by 5%. His goal is to power 100% of NTC and Ft Irwin by using RES, such

as wind turbines, and solar and geothermal power. He is working with Southern California Edison on a micro-grid to be independent from Barstow, CA, (the closest commercial grid from which the base is powered). His vision is that NTC and FT Irwin are a NET producer and actually resupplying Southern California.[83]

If RES can be productive, affordable, sustainable, and maintainable in a similar training environment to that of the Middle East, a strong case is made for RES in Iraq, Afghanistan, or other similar contingency operations.

Alternative Fuel Vehicles or Electric Vehicles

The Army must increase the use of Alternative Fuel Vehicles or Electric Vehicles for both non-tactical and tactical purposes in order to reduce dependence on oil from foreign sources, increase energy security, and alleviate existing oil supplies for soldiers.[84] There is a project that the Army is working on to make available up to 4,000 neighborhood electric vehicles for on-post use over the next three years replacing petroleum-fueled vehicles from the Army's non-tactical vehicle fleet. This is the first lease with the option of increasing purchases in future years to possibly 40,000 or two thirds of the CONUS Army NTV fleet. The benefits to the Army are petroleum reduction, fuel cost avoidance, and emissions reduction. There is an estimated petroleum reduction of 11.5 million total gallons, a maximum petroleum cost avoidance of 45.8 million dollars, and reduction in carbon dioxide emissions by 52% over a six year period.[85]

Secretary Geren hosted the Army Neighborhood Electric vehicle rollout 12 January 2009, at Fort Myer, VA. These vehicles are to be used for passenger transport, security patrol, maintenance, and delivery services. There are both four passenger

sedan models and two-passenger utility models. The utility model has a stake bed and a 1,000-pound payload capability, with an eight hours charge. The vehicles can travel 30 miles at a speed of 25 miles per hour. The fuel or energy costs for the vehicles are an estimated $460.00 annually versus an estimated $1,200.00 for gasoline-powered cars. While the NEV's are Non Tactical Vehicles, as part of the Future Combat Systems ground force modernization program, the Army is developing eight new hybrid electric powered Manned Ground Vehicles for armor forces. These fuel efficient vehicles will also reduce the Army's dependence on fuel.[86]

While the use of the NEV is a NTV and does not offer the same protection for the Soldier, as a tactical vehicle, it will nonetheless, save on equipment, and meet general everyday transportation needs on installations for which petroleum is often used unnecessarily. It is anticipated that this project is successful and that the advent of the NEV can be used on all military facilities nationally to reduce fuel use, dollars and emissions.

Alternative Fuels for Tactical Vehicles

Another recommendation is to increase the availability for alternative fuels for tactical vehicles. Federal law currently exempts tactical vehicles from using alternative fuels. However, this should not stop the Army from exploring the use of alternative fuels for its tactical vehicles. The Army needs to increase the fuel flexibility for all its vehicles to reduce oil usage and take advantage of new energy sources. Vehicles that can operate on more than one petroleum fuel, as well as alternative fuels, offers options to the Army for fueling combat vehicles. The Army should examine all forms of

alternative fuel and make investments in those fuel technologies that will provide additional energy security to tactical vehicles.[87]

Since combat/tactical vehicles make up 8% fuel usage in peacetime and 21% in wartime,[88] it would make sense to utilize other forms of renewable such as biomass or converting waste to energy, which has reached a mature stage of technology. Algae, switch-grass, ethanol, sugar cane, rapeseed, soybeans, miscanthus, are all viable alternatives currently making up the bio-fuel portfolio. They have technologically advanced and developed economically in the past two to five years

The Army currently has a demonstration project that will convert biomass waste to fuel. The project which was in concert with the Defense Energy Support Center is a mechanism to demonstrate waste-to-fuel technology on Army Installations. There will be no investment by the Army because DESC will reimburse the Army for all capital and operational expenditures, and it will serve as beneficial for the Army by turning waste into usable product, reduce the landfill waste disposal and provide the Army the ability to purchase liquid fuel for vehicles. Unfortunately, due to the current legislation the fuel would only be able to be used on non-tactical vehicles. However, by using this specific technology which will convert biomass material from cellulose waste streams, such as cardboard, grass clippings, and wood waste the demonstrations which will be conducted at six Army facilities starting in the third quarter of 2008 and concluding in second quarter of 2010, will be able to provide the leadership with a comprehensive demonstration which will enable them to discern whether it is a productive, sustainable investment for the Army.[89]

Therefore, while Science and Technology continue to perform research, development and testing, it only makes sense that the Army would begin to embrace alternatives equally, sustainable, and determine how to make it a productive method to utilize in our existing vehicle fleet, rather than concentrate on the future affordability of petroleum. This move to bio-waste, and continued exploration into bio-fuels, is additionally, a move to protect Americans from increased emissions.

Chapter 7

Summary/Recommendations

The U.S. and the Army acted appropriately during the 1980's regarding energy. As the paper clearly states both the U.S. and the Army were rather successful with conservation. However, when it came to an overall energy plan, particularly regarding RES and alternative forms of energy, whether the Army had one or two energy plans, there was still a failure in implementation.

By 1986, it appears leadership dropped both RES and alternative energy. The primary strategic focus, on energy was no longer present, and this in turn allowed the U.S., and the Army to become complacent in even the existing strides they made in conservation efforts.

Thus, during the early 1980's planning, research, development, testing, and evaluation occurred for RES, and conservation was recognized as a common business practice, however, few efforts were actualized. By 1985, the Army was virtually on the cusp of implementing a new energy plan, but failed to follow its' own recommendation and realize the promise of the 1980 and 1985 Army Energy Plans.

America now as a nation is both economically, politically, and strategically vulnerable from a national security perspective. We have a costly energy base with a reliance on oil, which makes us dependent on foreign sources, and should also prompt a concern for future national scarcity. The United States may be jeopardized by our continued reliance on oil for mobility. Increased international oil demand, reduced supply, incremental price increases, as well as periodic price spikes, may prove as the final impetus to encourage the leadership that continued reaction is no action.

This is due to the diminished supply the Army must be able to sustain the force in order to support two simultaneous contingency operations. Therefore, sustainability is now more than ever imperative.

There is also concern that our secondary source of energy coal should not be the only answer to supplement our existing supply of oil. While the exploration of clean coal technology is on the radar, the continued use of it promotes increased global warming and greenhouse gas issues.

Another challenge is that our national electrical infrastructure is brittle and antiquated. Since the Army CONUS installations are over 95% reliant upon the national electrical grid, the challenge of utilizing RES is all the more opportune.

Today, the Army is more vulnerable than ever due to political and economic challenges. While price spikes, have occurred periodically over the last three decades, we now have an even more powerful driver. There is the possibility that the supply of oil will not keep up with demand. In order to sustain this nation's prosperity and security, we must take steps to make it less vulnerable to energy price spikes. An important aspect of the solution is directly within the Army's control.

Recommendations

- The Army G-4 should explore using one single form of petroleum for contingency operations to increase logistical agility, product availability, and transporter safety.
- The Assistant Secretary of the Army for Acquisitions, Logistics and Technology, and the Army Research Development and Engineering Command should qualify blends of JP-8 and FT SPR of up to 50% volume for ground and engine systems.

- The United States Army Corps of Engineers, and the Army Research Development and Engineering Command, should take immediate action to island installations to increase the efficiency of critical equipment in order to reduce fuel for back-up systems.
- The Army G-4 and the Army Research Development and Engineering Command, should use RES particularly wind and solar to reduce continued dependence on fragile electrical systems. The Army should be working in CONUS first to assist with our secondary electrical requirements for facility operations.
- The United States Army Corps of Engineers and the Army Research and Development and Engineering Command should test micro-grids and intelligent power distribution systems, geothermal, solar, and wind technologies on CONUS based facilities first to see if viable. Make every effort to forecast demonstration OCONUS after they have first been vetted at CONUS based installations.
- The Army Research Development and Engineering command should advocate usage of RES and fielding of micro-grids and intelligent power distribution systems in CONUS first then OCONUS contingency operations.
- The Assistant Secretary of the Army for Acquisition, Logistics and Technology, and the Army Research Development and Engineering Command should develop armored manned hybrid electric vehicles for Combat forces.
- The Assistant Secretary of the Army for Acquisitions, Logistics and Technology, should collaborate with the private sector to invest in RES and the fielding of micro-grids and intelligent power distribution systems, to support the effort.

- The Assistant Secretary of the Army for Acquisition, Logistics and Technology and the Army Research Development and Engineering Command, should increase availability for alternative fuels that can meet the performance specifications for tactical fleet and exploit future systems, such as hybrid, electric fuel cells, and bio-fuels.
- The Assistant Secretary of the Army for Acquisition, Logistics and Technology, and the Army Research Development and Engineering Command should use alternative fuels for tactical vehicles to increase fuel flexibility for all vehicles to reduce petroleum usage and take advantage of new energy sources.
- The United States Army Corps of Engineers, the Assistant Chief of Installation and Management and Installation Management Command, should focus on higher level of efficiency and conservation at installations. Develop one efficiency level for buildings located on CONUS based facilities.
- The Assistant Chief of Staff of Installation Command and Installation Management Command should accelerate the utility metering program to ensure all buildings at all Army installations are metered by 2015.

These recommendations demonstrate how the Army should be in the process of transforming itself. The Army must be capable of operating, and maintaining the force in conflict for extended periods of time. This creates many challenges regarding the sustainability of resources. The greatest of the aforementioned challenges, is that we have too great a dependence on foreign oil in order to operate and meet mission. These recommendations would largely counter this trend.

Due to anticipated fiscal constraints, it is imperative the Army not only operate and meet mission, but also learn to do so in a more sustainable fashion. The recommendations previously articulated are a starting point. This would in turn make CONUS Army Installations and OCONUS Forward Operating Bases more energy sustainable and even net energy producers. It is now the Army's mission to lead the way and serve as an institutional model nationally for energy security and sustainability.

Chapter 8

Conclusion

The Army confronts four fundamental issues as it considers its ability to conduct future missions successfully. Those issues are:

1. Should the Army have the capability to continue to sustain the force with oil indefinitely? Based on the analysis of this paper the answer is a resounding no.
2. Should the Army reduce or eliminate existing contingency operations, due to our reduced capability to continue to sustain the force? This paper offers recommendations, which would continue to sustain the force, without reducing or eliminating contingency operations. The successful resolution of the recommendations identified in the paper, is crucial to determining the scope and robustness of future Army capabilities to conduct contingency operations or successfully prevail in force-on-force encounters. A force fueled by petroleum will be subject to vulnerabilities from both political military disruptions and from a failure of sufficient supply.
3. Should the Army continue to be permitted to consume energy at high rates with little effort at conservation? The paper addresses this consumption rate, especially regarding installations, and the answer is again a resounding no. The issue of conservation was readily being addressed in the 1980's and this plan of action should have continued.
4. Finally, does the Army have a greater interest in conservation and the use of RES than they did when they developed the initial Army Energy Plans in the 1980's? It is difficult to submit their interest is greater than it is today, however they did have plans in place that they failed to execute. By 1986, the U.S. was no longer involved in an oil crisis, oil was at a surplus, the economy was rebounding, conservation while it should have been, was no longer a consideration.

The Army Energy Security Implementation Strategy is the Army's blueprint to successfully deal with these four fundamental issues. Some of the same goals, objectives, activities, initiatives and projects of today's' Army Energy Security Implementation Strategy, are similar to many of the concepts discussed in the Army Energy Plans of 1980 and 1985. Will this new Army strategy succeed or will the Army lose the will to make the tough, smart energy choices as it did in the mid-1980's? The Army has the elements to succeed in the 21st century. The elements are leadership, a willingness to collaborate with private industry to find RES solutions and the presence of a new presidential administration that places great emphasis on fundamentally reordering American's energy choices.

Leadership. The Army created an Energy Champion when it established an SES-level leadership position in the Secretariat that was focused on new Army energy solutions. Mr. Paul Bollinger, Jr. is the first incumbent in that position, Deputy Assistant Secretary of the Army for Energy and Partnerships. According to Mr. Bollinger, "There is no single silver bullet, to answer the Army Energy Strategy. It will take bold leadership, a national vision, and a strategy to execute."[90]

What then distinguishes today's efforts from the Army's incomplete execution of its energy strategy in the mid-1980's? The fundamental difference is awareness of leadership today that the most recent petroleum price spike was driven by supply reductions as well as politico-military considerations. We face a future in which our traditional foreign-based petroleum suppliers may not have the capacity to meet future demand. Today's Army leaders are exhibiting a resolute will to reduce our demand, and shift our energy sources, while collaterally working to decrease the brittleness of our

domestic electric power supply. The Senior Army Energy Council has taken the first step by obtaining a commitment from the senior leadership to agree to support several projects and provide a monumental starting point which in roads can be made into RES: Renewable Solar Energy, installation auditing and metering, spray foam insulation for tents, Neighborhood Electric vehicles, Biomass Waste to Fuel Technology Demonstrations, and Geothermal Power Plants, are all good initiatives for establishing a diverse energy portfolio. The fact that the Army is taking strides in correcting the problem and anticipating the funding for such projects using the Plans, Programming Budgeting and Execution System is admirable. The Army has addressed the leadership problem by appointing a Senior Energy Executive, Senior Energy Council developing a charter and approving Army Energy Security Implementation Strategy all of which are enormous achievements.

Partnerships for energy alternatives. The Army is now more willing to collaborate with private industry in alternative forms of energy and RES, and vendors are more interested in availing their resources. The timing seems to be advantageous for both parties to be more fully vested in RES and alternative energy, in order to reduce American's overall dependence on foreign oil. New Presidential Administration. The timing also seems fortuitous to the Army with the advent of a new administration. It should be easier to garner financial support with legislative and executive branches of government, since both are proponents of implementing an energy strategy for the United States to be less dependent on foreign oil. These lawmakers and the President of the United States, understand we need an overall strategy for the U.S. to make us more energy secure as a nation, repair our brittle utility infrastructure, advocate

conservation methods, and reduce the harmful effects of greenhouse gases to salvage the environment and commit to ensuring our own health and safety, as well as that of future generations by reducing or eliminating harmful emissions.

Thus, everything is in our corner, private industry is on board, leadership is in place, timing is correct, and a strategy is being developed. Affordability is always a consideration; however dare we let history repeat itself. Can we bury our heads in the sands of Iraq and Afghanistan and forget that there is a reason why Service members have lost their lives, families and friends have lost their loved ones, and other Warriors have been severely injured performing contingency operations where they may never live the exact life they left prior to deploying? No, and by letting history repeat itself by a cycle of continual oil spikes, recovery, continued dependence on virtually one form of energy, oil, when the preponderance of it comes from other countries, would be a continued failure of leadership and unacceptable business practices. Soldiers need our protection, RES is proving to be sustainable, maintainable, and the productivity of the systems is being verified in CONUS for use at Army facilities and contingency based operations.

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